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Microstructural and electrical characterization of Nb-doped SrTiO₃ – YSZ composites for electrodes in solid oxide electrolysis applications

S. Bhaskar Reddy, P. Blennow and K.A. Nielsen.

Abstract

Nb-doped SrTiO₃ (Sr_{1-x}Ti_{0.9}Nb_{0.1}O₃, 0.01 ≤ x ≤ 0.06, henceforth known as STN) and 8 mol.% yttria stabilized zirconia (8YSZ) composites were prepared by mixing them in different volume fractions (between 10 vol.% - 50 vol.% of 8YSZ in the increments of 10 vol.%). The composites were compacted into pellets, sintered and evaluated for phase stability, phase interaction, microstructure and electrical conductivity. Microstructural analysis of the STN – 8YSZ composites revealed that above 30 vol.% of 8YSZ, the percolation of the STN phase was extremely limited. Phase analysis by X-ray diffraction showed no detectable secondary phases. However, segregation and formation of Nb enriched particles was observed in the 50 vol.% 8YSZ composite during microstructural analysis. Chemical analysis by energy dispersive spectroscopy (EDS) also showed the presence of Ti in the 8YSZ phase indicating the diffusion of Ti in to the 8YSZ phase. The inter-diffusion of elements from both phases was observed at least on small length scale through EDS analysis. The dc electrical conductivity measurements on the STN-8YSZ composites showed a drastic decrease in conductivity when more than 10 vol.% of 8YSZ was used in the composite. The initial metallic conductivity behavior changed to semiconducting type for more than 30 vol.% 8YSZ, confirming the percolation limit observed by the microstructural analysis.